

a division of
Carlson Communications Inc

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September 25, 1995

Subject: Comments on F.C.C. No. 95-281, C.C. Docket 95-115

Federal Communications Commission
Washington, D.C. 20554

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To The Commission:

Regarding the above referenced Docket, OptaPhone Systems offers the accompanying comments. The background below details our company's experience in rural telephony.

Background:

OptaPhone Systems Division of Carlson Communications, Inc. is a manufacturer of fixed rural radio telephone equipment. This equipment is generally used to extend conventional telephone service to areas where wireline construction would be too expensive or otherwise impractical. Our company's experience in wireless telephony dates from 1987, and the first OptaPhone radio telephones (our own manufacture) were delivered in 1990.

We have about 3500 lines in service in the U.S., with about 1500 of these provided by OptaPhone STAR multi-access radio telephone systems, and the balance by OptaPhone PLUS single line radio telephone systems. The typical OptaPhone STAR system installed provides service to 20 subscribers using 4 radio channels in the 454/459 MHz Rural Radio Service (BETRS) allocation. The largest STAR system we have installed domestically serves over 40 subscribers on 6 radio channels.

Our customer base include some Bell operating companies and other large providers, but the bulk of our domestic business is independent

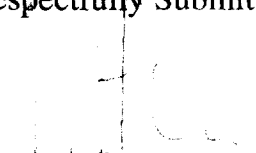
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telephone companies. Our systems are designed to provide service equal to conventional wirelines in both access and voice quality, although access (grade of service) is limited by the number of radio channels available.

We offer the comments following, and refer to a magazine article entitled "Multi-Access Radio Links an Alaskan Village to the World" published in the September 1995 issue of COMMUNICATIONS magazine, which has material directly relevant to the issues.

Respectfully Submitted:


James P. Longnecker
Senior Applications Engineer

Enclosures:

Multi Access Radio.....

OptaPhone 2000 System Brochure

Comments on Paragraphs 40, 41 and 44

Comments:

OptaPhone Systems offers comments on Section C., Paragraphs 40, 41 and 44.

40. Regarding availability:

(1.) We believe that most LECs, particularly the smaller independent carriers in the rural west (where the bulk of unserved subscribers are located) have been diligent in searching for alternatives to conventional wirelines to provide service to unserved subscribers within their filed territories. The alternatives used to provide service have included fixed radio (wireless local loop) equipment such as offered by OptaPhone Systems and Interdigital Communications.

(2.) There remain a significant number of unserved subscribers who are located outside of the boundaries of "filed territories", which are the telephone service areas as defined by the individual state public utilities commissions. These subscribers vary from "new pioneer" families who have set up homes outside of existing telephone company service areas, to significant settlements or whole communities that have never had telephone service. Some of these communities are undergoing increases in population due to an influx of new residents including retirees, while others are unserved due to a combination of geographic and cultural isolation. The entire Yurok Indian reservation in Northwestern California remains without telephone service of any kind in 1995.

There are isolated communities without conventional or cellular telephone service in most of the western states, including Alaska and Hawaii. Our company is especially aware of these areas as we often receive requests from individuals attempting to provide their own link to the telephone infrastructure. It is difficult to put a number on the households without telephone service, but we estimate this is at least several tens of thousands, since we have had contact with more than 2000 such individuals over 6 years.

Other than trying to persuade nearby a LEC to serve them (generally at the burden of the other rate payers in the company's service area) citizens outside of filed territories in most cases do not have any likelihood of getting telephone service.

We would request that an incentive program be studied, possibly offering financial aid to existing or neighboring carriers that to extend service to these areas without burdening the existing rate payers for the additional costs. We believe that the current infrastructure of the R.U.S. is well suited to be a channel for such incentives, if this agency could legally do so.

41. BETRS Rural Radio Telephony

The majority of OptaPhone fixed radio telephone systems provided to LECs have been delivered on 454/459 MHz BETRS frequencies, with perhaps 10% on 152/157 MHz frequencies. The 800 MHz frequencies assigned to BETRS have not been widely used, because manufacturers including ourselves question whether these frequencies will remain available to this service long enough to pay for product development in this band.

The status change to co-primary has increased spectrum availability in some areas. The small amount of radio spectrum available for fixed rural radio telephony in the BETRS band is cited by our customers as the largest limiting factor in providing service by wireless means. A second consideration that these customers have mentioned is the lengthy processes necessary to obtain licenses from the F.C.C. The accompanying magazine article mentioned a "2 year wait" for a license, which probably included the preparation time prior to filing.

We request that additional spectrum, possibly the old "air to ground" channels adjacent to the current BETRS band, be made available to the rural radio service on a co-primary basis. The proximity of this band to the current band means that immediate relief using existing technologies could be afforded to LECs using radio as a means to extend telephone service.

We also request that a study be made of the use of offset or 12.5 KHz frequency assignments within the existing BETRS band. Our experience with the use of narrowband FM modulation techniques indicates that assignments at 12.5 KHz with some geographical separation would increase frequency availability. Digital modulation schemes may not be compatible with this type of "refarming", however.

We request that a streamlining of the licensing processes be considered, with the commission considering the possibility of assigning the engineering review and interference studies of this

task to some semi-private organization such as an industry association. Our customers report that current license waiting times for Part 22 filings range from 4 to 18 months.

44. Penetration levels for telephone service in the U.S.

(1.) We believe that there are some individuals and families who choose not to have telephone service, but we also believe that many of these people have not been made aware that the technology exists to provide them with connectivity. As an example, please refer to the new demand for service experienced by P.T.I. after installation of the BETRS system as chronicled in the accompanying article.

(2.) Since a significant number of OptaPhone fixed radio telephone systems delivered have been installed to serve Native American residents, our company has had considerable contact with members of this community. We believe that telephone penetration among Native Americans is significantly less than other minorities, for reasons both geographical and financial. We would encourage any program to rectify this problem.

SEPTEMBER 1995

Communications

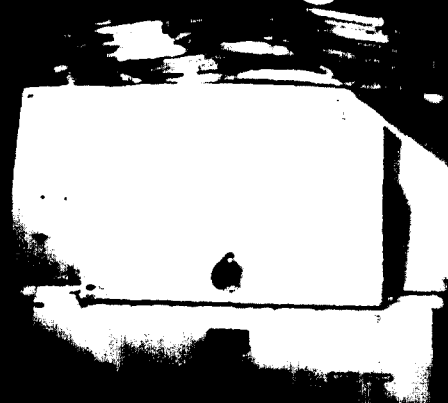
FOR WIRELESS COMMUNICATIONS PROFESSIONALS



Radiotelephone Gives Alaskan Service to Village

Continued from the
Paging Industry

The Digital vs.
Analog Debate



Special
PCS Section
Inside!

Multi-Access Radio *Links an* Alaskan Village *to the* World

Where wireline was prohibitively expensive, rural radiotelephone gave South Thorne Bay full-featured service for the first time.

*By Ronald F. Jones
Jones-Molé & Associates*

Businesses and residents in Thorne Bay, a logging community of 375 people on Prince of Wales Island in southeast Alaska, enjoy conventional power and telephone service. But just half a mile across Thorne Bay lies the more isolated village of South Thorne Bay, with about 120 residents. Here the only electricity comes from small personal generators, and until early this year, standard telephone service was not available.

Whereas Thorne Bay is fully accessible by automobile, roads are very limited within South Thorne Bay, and the village is accessible only by boat or float plane. Half the homes can be reached only by foot trails. This difficult access is fine with the local residents; after all, they chose this rugged lifestyle. But, like people in isolated villages around the world, the hearty souls who live in South Thorne Bay have an increasing need and desire to be connected to each other and the world via standard telephone service.

The local telephone operating company is PTI Communications, based in Anchorage, providing 75,000 lines in Alaska. Demand for telephone service in South Thorne Bay had been mounting for years and had grown to 23 requests

last January when PTI began to install a new multi-access radio system made by OptaPhone Systems.

Searching for a viable technology

Before selecting the OptaPhone STAR 2000 system to satisfy this growing demand for telephone service, PTI found itself in a tough bind. It wanted to satisfy the South Thorne Bay residents' requests for service but had no viable technology that would offer the kind of high-quality phone service the company was committed to providing its customers.

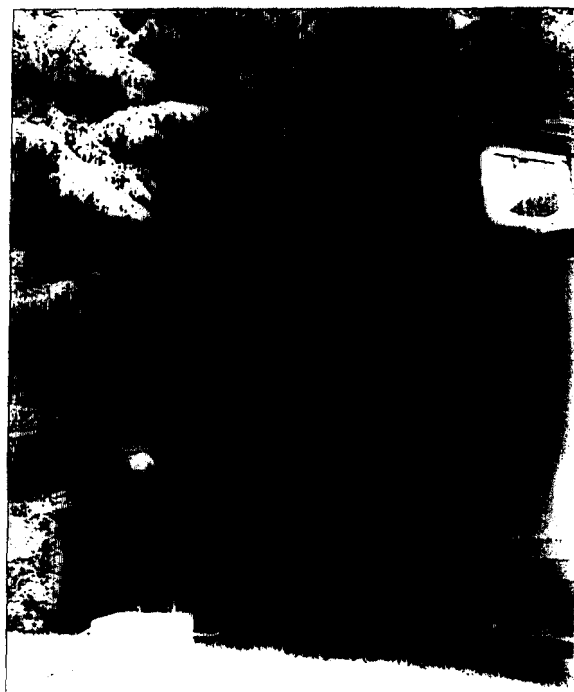
"Residents had been pleading with us for service for years, but we couldn't find anything reliable enough to serve them," said PTI area supervisor Wayne Stott. "Conventional outside plant construction was just too expensive and out of the question."

Wireline installation would have required putting all the poles and equipment in a skiff, boating it across the bay, then packing it in on foot trails. That would be after installing wireline several miles around the bay. Derrell Webb, PTI's network engineering superintendent, estimated the cost to build around the bay and into South Thorne Bay with traditional wireline would have run between \$700,000 and \$1 million – far more than the economics could justify for a subscriber base that small.

PTI's network construction supervisor Dean Rhoades said cellular phone service was available but "ninety bucks a month for service was considered way too expensive for this area." And since the

two South Thorne Bay wilderness lodge businesses requesting service also wanted to employ fax machines, the noted difficulty with cellular data transmission would have been problematic as well.

Rhoades met Jim Carlson, OptaPhone's chief executive officer, at an Alaska Telephone Association trade show in Anchorage. "Jim seemed confi-



dent that his new OptaPhone STAR system could satisfy our need for a quality connection at a cost-effective price," said Rhoades.

After further discussions and on-site evaluation with OptaPhone test equipment, PTI approved the project. Following a two year wait for the Federal Communications Commission (FCC) to grant

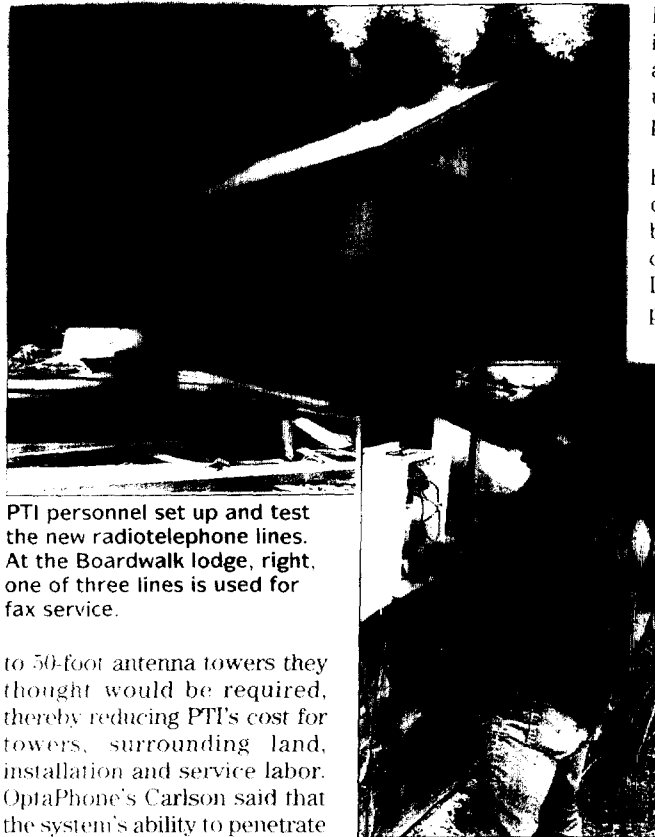
the UHF frequencies allocated under the FCC's 1988 BETRS (Basic Exchange Telecommunications Radio Service) ruling, installation of the original 23 lines began in January 1995. Since then, demand for new service has been heavy, and the number of lines installed rose to 42 just six months later.

Strong signal, huge savings

The six-channel base station is installed in the central office at Thorne Bay. The two hunting and fishing lodges, McFarland's Floatel and the Boardwalk, are just one-half mile across bay on the water's edge. The most distant subscriber installations are 3-1/2 miles from the base station, well within the system's line-of-sight transmission range of 30-50 miles.

The STAR 2000 base uses an omnidirectional antenna to cover the wide service area, and the 42 subscriber stations use directional antennas, mostly Yagis, pointed toward the base. The base at the Thorne Bay central office is AC-powered with DC back-up. The South Thorne Bay customers power their own subscriber stations with gas or diesel generators.

Rhoades said the installation went "pretty well, though some problems needed to be solved." For example, the signal was actually too strong at first, requiring the subscriber site radios to be individually padded to reduce the received signal strength. However, according to Rhoades,



PTI personnel set up and test the new radiotelephone lines. At the Boardwalk lodge, right, one of three lines is used for fax service.

to 50-foot antenna towers they thought would be required, thereby reducing PTI's cost for towers, surrounding land, installation and service labor. OptaPhone's Carlson said that the system's ability to penetrate through foliage is largely a function of using narrowband analog UHF transmission, which increases receiver sensitivity and allows greater range and enhanced ability to overcome terrain obstacles.

Webb estimated total costs for the OptaPhone installation will result in a 70 to 80 percent savings over the projected wireline costs.

Blessings of phone service

PTI originally estimated the initial subscriber base of 23 would include almost everyone in South Thorne Bay who wanted a phone, but in fact the demand almost doubled in less than six months. "People literally came out of the woods when they found out they could get a phone," said Rhoades. Stott said the newly available phone service is proving "a big factor in peo-

ple deciding to move up and build on their sites. Now you see want ads that say 'lot for sale, phone service available.'"

Rhoades said audio quality is "clear as a bell, not distorted a bit." Still, a few problems occur, such as some false ringing.

But PTI says these issues are being addressed by the manufacturer with telephone support.

The Boardwalk lodge has three lines installed: one for guests, one for business and one dedicated to a fax machine. Initially, there was a problem with interference due to the three co-located antennas, but it was quickly solved with factory support.

"Business would be impossible to conduct without this telephone communication," said Donna Ibbetson, a Boardwalk partner. "Before we had phone service, we used marine radio for emergencies, but it was extremely limited."

The system's full fax and data capability was also part of PTI's decision to deploy the OptaPhone STAR 2000. Rhoades reported the Boardwalk owners "are thrilled with the fax. They say they've never missed any portion of a fax yet."

Jean McFarland, co-owner with her husband Jim of McFarland's Floatel lodge, said the new phone service has "definitely helped us out. Before we had this service one of us had to go across the bay every day to get messages from an answering machine in Thorne Bay." In addition to the inconvenience, McFarland said this practice dampened business.

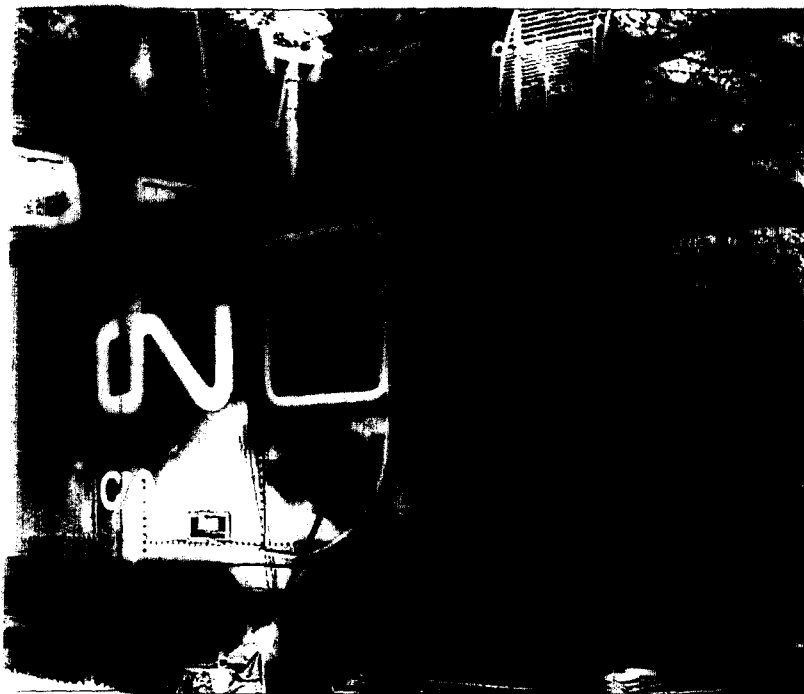
"When people are ready to book a lodging, they want to talk to someone right away," she explained. "If they can't reach you right then, they'll call somewhere else so this has helped us considerably."

Inside the lodge the McFarlands also operate a store, Baskets & Bullets, where they sell fishing and hunting supplies, as well as Jean's pine needle raffia basketry. With phone service, she has increased her mail order business. "People can call me now with orders. I'm in touch with craft shops and guilds across the United States."

The FDMA technology

In the South Thorne Bay installation, the STAR 2000 utilizes six full-duplex radio channels to deliver the 42 telephone lines across the bay. When all six channels are in use simultaneously, the seventh person to go off-hook gets a busy signal, then a ring back when a channel becomes available.

The STAR exchange station is installed on standard racks in the Thorne Bay cen-



Many homes in rural Alaska, including this caboose, are often hidden in wild areas that cannot be reached by wireline phone service.

"The problems we had were not abnormal for a first-time installation."

PTI was pleasantly surprised by the system's ability to transmit a strong signal through dense trees and foliage. This precluded the need for the extra-high 40-

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Hark® To Produce Equipment for Monitoring Tower Site Alarms

Hark has been contracted by Motorola to provide tower site monitoring equipment. This equipment will monitor tower lights and alarm inputs as well as provide remote card access. Equipment will be sold directly to Motorola as well as on the open market.

Installation Updates:

New Mega Switch installs include two units for Pittencrieff Communications Inc. located in Abilene and Odessa, Texas

Cleveland Mobile Teletrak located in Cleveland, Ohio

New Feature Update:

A new feature has been added to the TAP 200, Alpha Numeric Concentrator. This feature prevents unauthorized group calls from gaining access to the paging terminal. All new units will automatically have this feature. Existing Tap 200 units may obtain an updated prom to be replaced on site.



A radio base station in Thorn Bay transmits to 42 subscribers across the bay, including McFarlands Floatel, pictured here.

user and functions like a wireline connection. The only distinction between this radio-based telephone system and a wireline system is the means of connecting the telephone to the central office. All other functions, such as central office switching and billing, are handled just as if it were a standard wireline connection.

tral office, though it is more typically housed in an enclosure about the size of a small refrigerator and installed at a wireline loop end at a point on the line where antenna placement is optimal. In the South Thorne Bay installa-

Other system features include frequency-agile tuning, microprocessor-controlled operation, surface-mount technology and low-power consumption. Although the northern latitudes of Alaska preclude solar-powered operation, the low current draw -- 12 amps with all channels operating, .5 amps when idle at the base station, one amp off-hook and .15 amps idle at the subscriber station -- make solar powering economically feasible in most regions of the world.

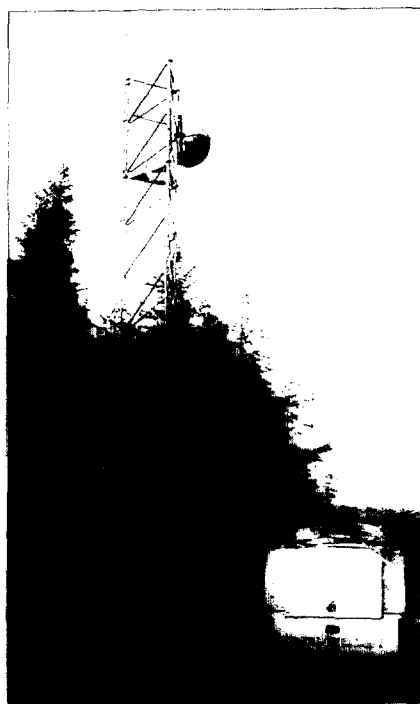
Modular design also permits simple field-level repair, an important feature for remote sites like South Thorne Bay.

What happens next?

With demand continuing to grow in South Thorne Bay, PTI plans to expand the system, possibly to 80 or 90 subscribers on the same six-channel base. Six channels is the maximum a single STAR 2000 base station will accommodate. As the number of lines grows, however, the trunking ability of six channels becomes more strained.

Carlson said that whenever grade of service conditions get marginal -- when people get a reorder tone (or "fast busy") too often to be satisfied -- a parallel base station can add two to six channels more to share the load and boost grade of service. Beyond the South Thorne Bay installation, Webb said, "We're looking at plans to order more systems for other areas we serve."

In a telecommunications world that is rapidly "going digital," using FDMA equipment in South Thorne Bay is a reminder that state-of-the-art analog technology may still hold an advantage over digital systems for many low-density rural applications.



An omni-directional antenna sits atop the central office in Thorne Bay.

tion, the central office was well situated for good radio transmission.

The base station accepts 42 two-wire line feeds from the central office and, using a unique trunking architecture, delivers the lines, each with its individual network identification, to the 42 subscriber stations. The subscriber radio equipment is housed in a compact, lightweight, weatherproof fiberglass enclosure. Customers plug their own telephone, fax or modem into the subscriber station with an RJ-11 jack, as if it were being connected to a wireline outlet.

The system is transparent to the end

About the Author
Ronald F. Jones is a corporate communications consultant and partner of Jones-Molé & Associates in Garberville, Calif.

OPTAPHONE

2000

RURAL RADIO TELEPHONE SYSTEM

a product of Carlson Communications, Inc.

***A complete wireless solution
featuring fully integrated point-to-point links
and FDMA point-to-multipoint systems –
combines the best features of wireline
telephony with the latest radio advantages!***

MEETS WIRELINE TELEPHONE STANDARDS FOR:

- **Audio & Data Quality**
- **Customer Features**
- **System Reliability**
- **On-Site Serviceability**
- **Grade of Service**

ADVANCED RADIO SYSTEMS TECHNOLOGY TO PROVIDE:

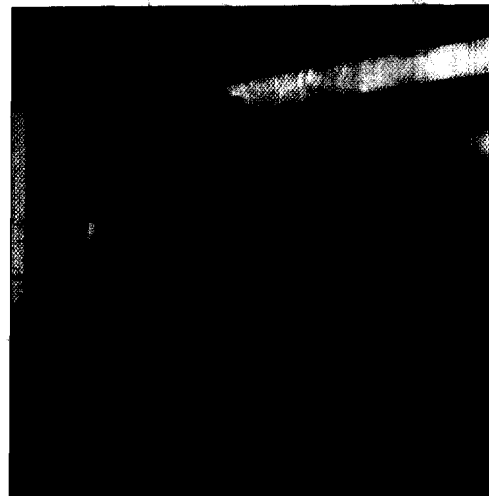
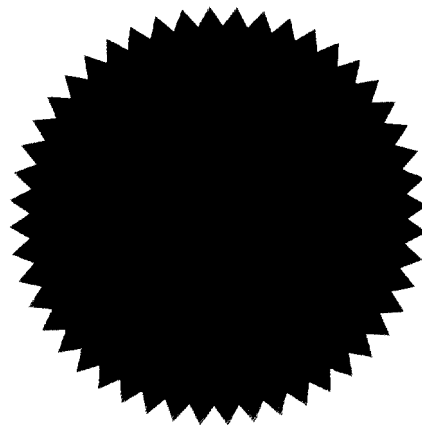
- **Low Start-Up & Operating Cost**
- **Efficient & Flexible Spectrum Utilization**
- **Fast, Simple Installation**
- **Exceptional Field Adaptability**

***Serves low-density rural subscribers with
full-featured telephone service at quality and
cost levels comparable to urban subscribers.***

***Low initial cost and quick installation
yield rapid investment recovery.***

***No community too small to serve –
even a single subscriber can be cost-effective!***

Conforms to all applicable CCITT and North American standards



OPTAPHONE 2000 RURAL RADIO TELEPHONE SYSTEM

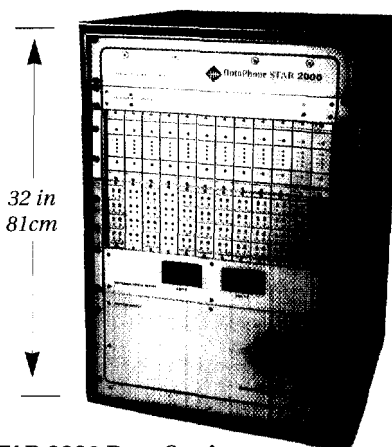
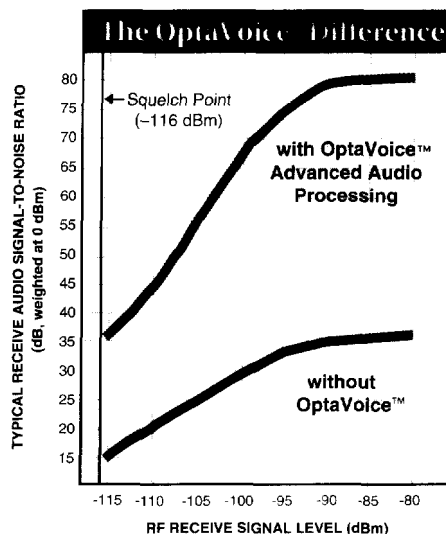
a product of Carlson Communications, Inc.

In a major advance for rural telephony, Carlson Communications introduces the OptaPhone 2000 Rural Radio Telephone System. By using modular, microprocessor-controlled, surface-mount technology, the OptaPhone 2000 upgrades and fully integrates OptaPhone's original point-to-point and point-to-multipoint products, the OptaPhone PLUS and OptaPhone STAR. The new PLUS 2000 and STAR 2000 work together to give the service provider unprecedented network design flexibility and improved system performance.

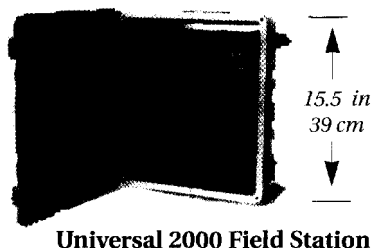
A single STAR 2000 FDMA (frequency division multiple access) system can serve a maximum of 48 subscribers. By deploying two or more parallel STAR 2000 systems – and additional PLUS 2000 links to serve heavy users and isolated subscribers – OptaPhone 2000 offers an affordable alternative to expensive TDMA or fixed cellular systems when serving 120 subscribers or less. Key benefits include:

- Programmable frequencies and modular construction make all field stations reconfigurable and interchangeable, enabling cost-effective expansion and redeployment as demand grows or usage patterns change.
- Modular design greatly simplifies service & repair and substantially reduces the need for specialized RF training.
- Energy-efficient design minimizes and regulates current draw, enabling solar-powered operation in most regions of the world.

The OptaPhone 2000 is the ideal radio system for low-density rural telephone networks, designed for years of economical, dependable and adaptable use and re-use.



STAR 2000 Base Station



Universal 2000 Field Station



Installer mounts OptaPhone 2000 field station, solar panel box and a Yagi antenna on a single pole.

FULL-DUPLEX, WIRELINE-QUALITY AUDIO & DATA

- OptaVoice™ advanced audio processing circuit combines audio companding and switched-capacitor bandpass filters to achieve crystal-clear audio
- Delivers up to 14,400 bps modem and G3 fax capability
- 300–3400 Hz voice band transmission
- Track-tuned front end improves receiver selectivity
- State-of-the-art frequency control
- Dynamic RF power control monitors received signal level and adjusts RF power accordingly to maintain consistent fade margin

EFFICIENT & FLEXIBLE SPECTRUM UTILIZATION

- Narrow bandwidth (12.5 kHz) enables highly efficient spectrum use
- Low RF power output facilitates frequency reuse
- Synthesized, frequency-agile system accommodates changes in frequency allocations and planning
- A single FDMA STAR 2000 system serves 6 to 48 subscribers using 2 to 6 frequency pairs occupying only 50 to 150 kHz of spectrum
- In frequency-restricted service areas, multiple PLUS 2000 point-to-point links can share up to six frequencies

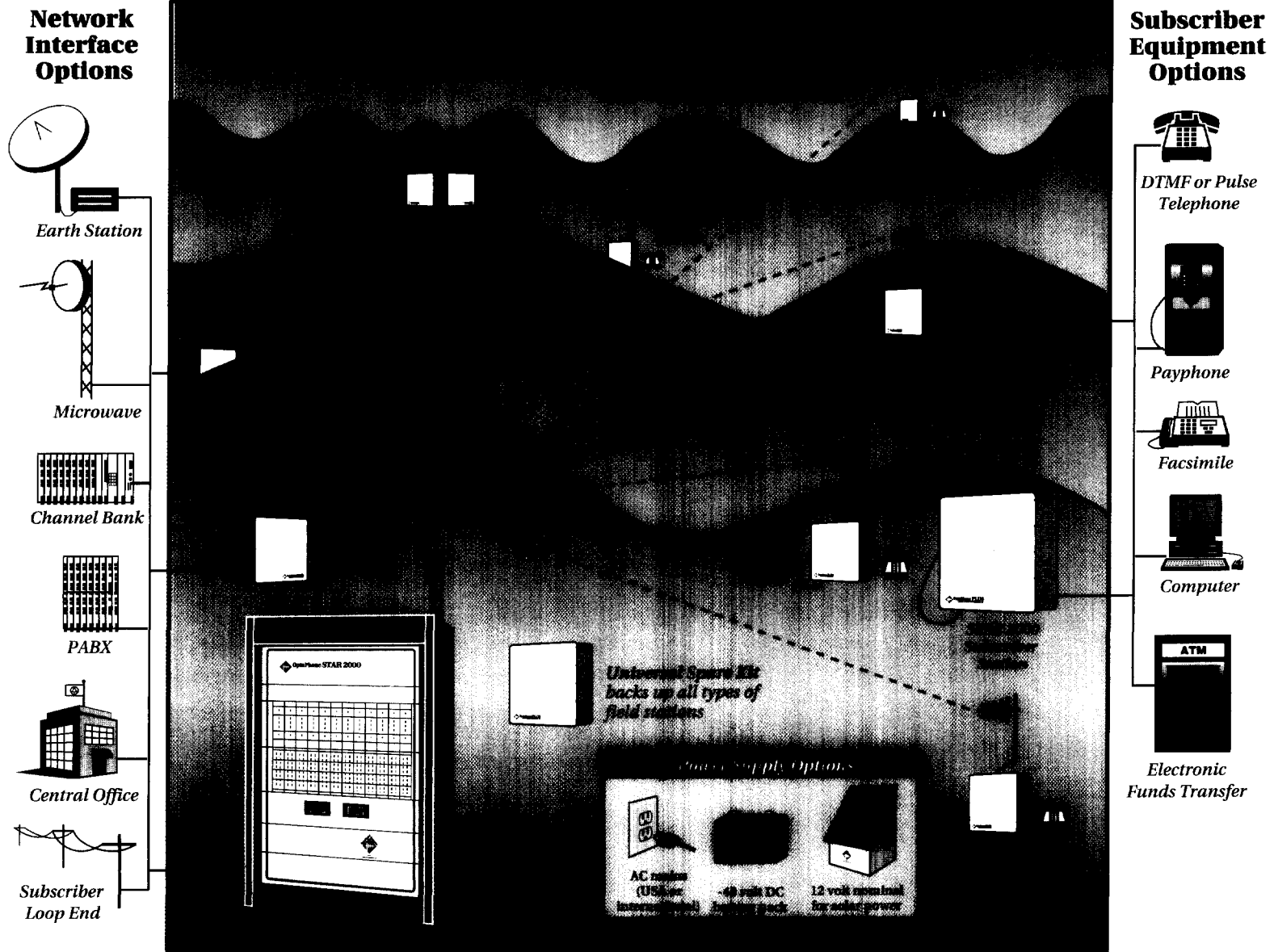
LOW START-UP & OPERATING COST

- Much more cost-effective than running wireline to rural and remote sites
- Minimal up-front training required
- Small cache of universal spares backs up numerous field stations of all types
- Low current draw – just 150 mA idle, 1.0 A off-hook – reduces energy bill and cost of solar panels and/or back-up batteries

FAST, SIMPLE INSTALLATION

- Compact, lightweight field stations
- One-person field station installation; no special equipment required
- Interfaces transparently with CO and customer equipment; can connect to T1 or E1 line with channel bank
- Rarely needs line balancing – just “plug & play”
- Simple-to-use OptaPhone Systems path test equipment facilitates radio path optimization

Unprecedented Network Design Flexibility for Small Rural Communities



EXCEPTIONAL ADAPTABILITY IN THE FIELD

- Universal field station can be converted to an exchange station or subscriber station by changing just the line interface card
- Subscriber station can be switched between STAR 2000 and PLUS 2000 with rotary switch
- Payphone capability available as a plug-in card
- The PLUS 2000 exchange station can be quickly configured with block jumpers on the interface card to either 2-wire or 4-wire + E&M telephone exchange line
- SF signaling optional as a plug-in card
- STAR 2000 base can be initially installed with as few as 2 trunking channels and then incrementally expanded up to 6 in the field as demand increases
- Synthesized frequency tuning:
 - Use rotary switch to select from up to 100 programmed frequencies on PLUS 2000 stations, or to set user ID on STAR 2000 subscriber stations
 - New list of frequencies or user IDs can be reprogrammed on site with laptop computer
- Even the frequency band can be changed by switching radio cards, duplexers, and antennas
- Up to 50 km line-of-site range; back-to-back repeaters can extend range
- Use of narrowband transmission increases receiver sensitivity, allowing greater range and enhanced ability to overcome terrain obstacles
- Field stations run off AC or 12 VDC or 48 VDC
- Low current draw enables economic solar-powered operation in most regions of the world

FULL-FEATURED TELEPHONE SERVICE

- Can support telephone, computer, fax, payphone or ATM terminals
- Up to 14,400 bps data transmission
- User-activated inversion voice scrambling
- DTMF tone or pulse dialing

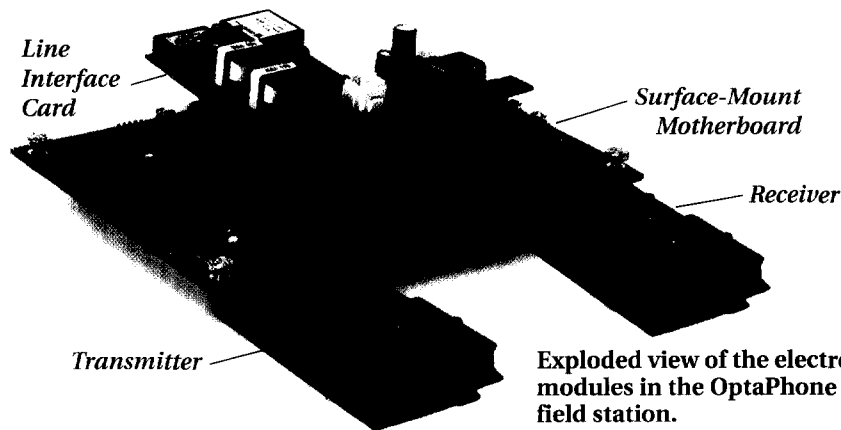
HIGH GRADE OF SERVICE

- As demand increases on partially loaded STAR 2000 systems, grade of service is maintained quickly and economically by adding new channels and subscriber capacity
- Each 6-channel STAR 2000 system can typically support 30 subscribers with P01 grade of service, or 48 subscribers with P05 grade of service
- A high-usage STAR 2000 subscriber can be easily converted to a dedicated line PLUS 2000 subscriber, improving grade of service for all parties
- High system reliability and fast on-site serviceability substantially reduce downtime and enhance overall grade of service

ON-SITE SERVICEABILITY

- Modular design and frequency agility enable a single universal spare kit to back up all types of field stations
- Four LEDs provide continuous on-line display of operational status for on-site diagnostics
- A malfunctioning unit can be either replaced by a universal spare or repaired on site by simply replacing line card, radio or other modular unit – no need to go back to a repair shop or the factory
- Field station duplexer, power supply and battery are all “screwdriver removable”
- All STAR 2000 base modules easily removable for service or expansion
- Minimal need for specialized training
- Future software upgrades can be installed on site with a laptop computer

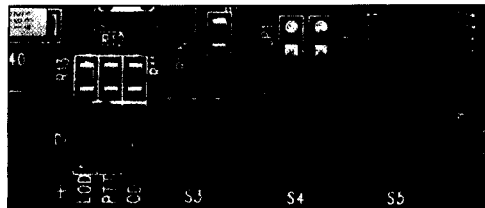
OptaPhone 2000 Modular Technology



Exploded view of the electronics modules in the OptaPhone 2000 field station.



Motherboard assembly with plug-in radio modules and line interface card removes easily for reconfiguration or service.

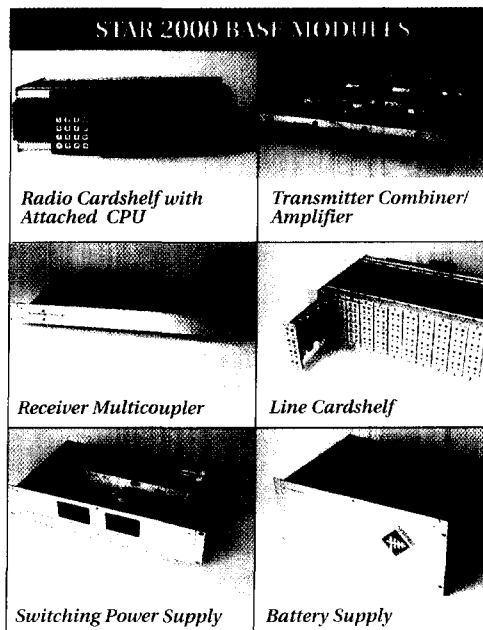


Programmed frequencies and user IDs selected with 3 rotary switches on motherboard.

- OptaPhone 2000 technology platform designed to retrofit future hardware upgrades with modular card exchange on generic motherboard

HIGH SYSTEM RELIABILITY

- Rugged surface-mount technology provides built-in reliability
- Energy-efficient design reduces system heat and promotes longer component life
- Low RF power output draws less current
- Microprocessor monitors and controls RF power output and total system power usage
- Low current draw extends battery back-up
- Self diagnostics:
 - System self-tests each time it is turned on
 - CPU's supervisory circuit automatically reboots system if lightning or other problem-causes processor interrupt
 - Remote loop test and battery check of subscriber station from exchange station
- Low voltage protection prevents battery destruction from deep discharge
- Shock-proof, moisture-proof NEMA 4X cabinet
- Wide temperature range and environmental tolerance
- Modular serviceability boosts overall system reliability



OPTAPHONE 2000 SYSTEM SPECIFICATIONS

STAR 2000 Base Station

General Specifications

Type of Operation	Trunked multipoint, multi-channel, full-duplex rural radio telephone
Line Capacity	Up to 48 lines
RF Trunk Channels	6 full duplex maximum; 2 minimum
System Signal-to-Noise Ratio	Greater than 68 dB (less than 20 dBncO)
Through-System Distortion	Less than 3% at 1 kHz, 0 dBm
Through-System Channel Loss	Less than 2 dB
Frequency Response	+1, -6 dB; 300-3400 Hz referenced to 1000 Hz
Data Throughput	up to 14.4 kb/s, 9.6 kb/s typical, G-3 FAX

Environmental Specifications

Operating Temperature	+60 C to -30 C
Humidity	to 95% non-condensing
Shock & Vibration	MIL 810 D
Direct Exposure to Elements	NEMA 3R with Hennessy outdoor cabinet

Power Requirements

AC Operation	90-260 VAC, 45-65 Hz
DC Operation	12, 24, or 48 VDC
Current Consumption @ 12 VDC	500 mA idle, 12 A all channels transmitting

RF Specifications

Frequency Ranges Available	144-174 MHz; 403-430 MHz; 450-470 MHz
RF Power Output	1.5 watts per channel
TX Frequency Stability	2.5 ppm
TX/RX Separation	5 MHz minimum
Channel Separation	25 kHz minimum, 600 kHz maximum
Modulation Type	16KOF3E, 16KOF2E (data)
Modulation Scheme	Dual Port FM Companded
Antenna Connections	Type N Female
RF Impedance	50 ohms
RX Sensitivity	0.35 microvolts (-116 dBm) 12 dB SINAD typical
RX Selectivity	65 dB typical

Network Interface Specifications

Standard Interface	Up to 48 2-wire loop inputs
Audio Impedance	600 ohms inputs/outputs
Connection	Amphenol type 57
Signaling to Network	DTMF or dial pulse 10 pps

Mechanical Specifications

BUD INDOOR CABINET

Construction	Painted steel, NEMA standard 19-inch rack cabinet
Dimensions	32 x 21 x 21 inches; 81 x 53 x 53 cm
Weight	70 lbs., 32 kg
Finish	Blue powder coat cabinet

HENNESSY OUTDOOR CABINET

Construction	NEMA 3R, 0.125 sheet aluminum
Dimensions	46 x 24 x 20 inches; 117 x 64 x 51 cm
Weight	120 lbs., 55 kg
Finish	White baked enamel

ECS TRANSPORTABLE ENCLOSURE

(Dimensions w/o battery tray; not supplied with transportable version)

Construction	Thermoplastic molded composite, NEMA standard 19 inch rack inside on rubber shock mounts.
Dimensions	28 x 22 x 22 inches; 71 x 56 x 56 cm
Weight	98 lbs., 45 kg

BASE WITHOUT CABINET

(Dimensions given in inches and in EIA standard rack units; 1.75" per rack unit)

Rack Depth (minimum)	17.50 in., 44 cm
System Height	28.00 in., 16 units
without Power Supply & Battery	15.75 in., 9 units
Module Heights:	
Transmitter Combiner/Amplifier	3.50 in., 2 units
Receiver Multicoupler	1.75 in., 1 unit
Radio Cardsheft w/ Attached CPU	5.25 in., 3 units
Line Cardsheft	5.25 in., 3 units
Switching Power Supply	3.50 in., 2 units
Battery Supply	8.75 in., 5 units

PLUS 2000 and STAR 2000 Universal Field Station

General Specifications

Type of Operation	One voice channel, full duplex
System Signal-to-Noise Ratio	Greater than 68 dB (less than 20 dBncO)
Through-System Distortion	Less than 3% at 1 kHz, 0 dBm
Frequency Response	+1, -6 dB; 300-3000 Hz referenced to 1000 Hz
Data Throughput	up to 14.4 kb/s, 9.6 kb/s typical, G-3 FAX

Environmental Specifications

Operating Temperature	+60 C to -30 C
Humidity	to 95% non-condensing
Shock & Vibration	MIL 810 D
Direct Exposure to Elements	NEMA 4X with Stahlin enclosure

Power Requirements

AC Operation	90-260 VAC, 45-64 Hz
DC Operation	12-15 VDC standard; 22-72 VDC optional
Current Consumption @ 12 VDC	150 mA idle, 1 A off-hook

RF Specifications

Frequency Range	TX/RX Separation	Frequency Stability
144-174 MHz	4.5 MHz	5 ppm
403-430 MHz	5.0-10.0 MHz	5, 2.5 ppm
450-470 MHz	5.0-10.0 MHz	5, 2.5 ppm
RF Power Output		2 watts
Modulation Type		16KOF3E, 16KOF2E (data)
Modulation Scheme		Dual Port FM Companded
Antenna Connection		Type N Female
RF Impedance		50 ohms
RX Sensitivity		0.35 microvolts (-116 dBm) 12 dB SINAD typical
RX Selectivity		65 dB typical

Interface Specifications – PLUS 2000 Exchange Station

Standard Interface	2-Wire or 4-Wire + E&M (jumper selected)
Optional Interface	2600 or 3825 Hz SF
Trunk or Tie Line Version	4-wire w/ E&M input and output
Maximum Loop from CO	1700 ohms
Ringer Equivalence	20,000 ohms 15-60 Hz (0.4 B)
4-Wire Audio Impedance	600 ohms input/output
2-Wire Audio Impedance	900 ohms input/output + 2.16 uF
Connection	RJ-11, RJ-14 w/ E&M signaling
4-Wire Audio Level Input from Network	-16 to +7 dBm
4-Wire Audio Level Output to Network	-16 to +7 dBm
2-Wire Hybrid Return Loss	Greater than 33 dB
Signaling to Network	DTMF, dial pulse 10 or 20 pps, programmable make/break

Interface Specifications – PLUS 2000 & STAR 2000 Subscriber Station

Loop Voltage to Telephone Set	24 VDC (-48 VDC optional)
Loop Resistance	900 ohms + 2.16 uF
2-Wire Hybrid Return Loss	Greater than 33 dB
Ring Signaling	86 VAC 20 Hz; 16 Hz optional
Connection	RJ-11
Audio Level Output to Set	-30 to +4 dBm
Signaling Acceptance	DTMF, dial pulse 10-20 pps

Mechanical Specifications

STAHLIN NEMA 4X MOLDED FIBERGLASS ENCLOSURE

Dimensions	15.5 x 13.5 x 6.25 in; 39 x 34 x 16 cm
Weight	7.2 lbs., 3.3 kg
(with AC or -48 VDC P/S)	7.5 lbs., 3.4 kg
(with Battery Back-Up)	16.5 lbs., 7.5 kg
Finish	Gloss white molded finish

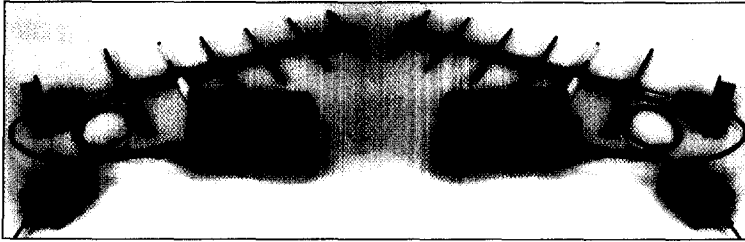
EIA STD 19" RACK-MOUNTED ENCLOSURE

Dimensions	48 x 25 x 13.5 cm; 19 x 10 x 5.25 in
Weight	6.6 lbs., 3.0 kg
(with AC or -48 VDC P/S)	6.8 lbs., 3.1 kg
(with Power Supply and Battery Back-Up)	16.5 lbs., 7.5 kg
Finish	Clear anodized aluminum

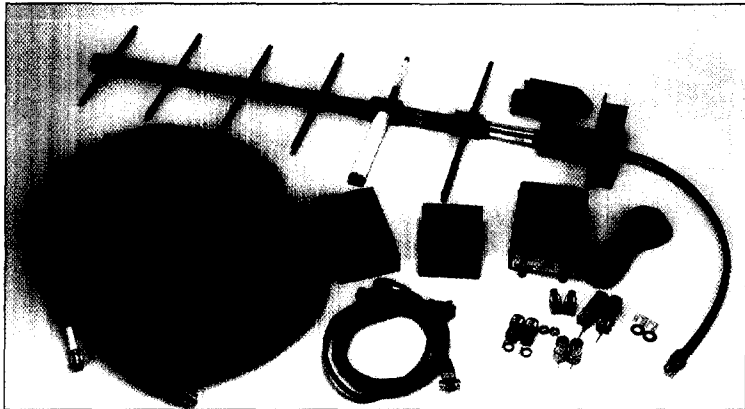
Specifications subject to change without notice.

COMPREHENSIVE FACTORY SUPPORT

- Assistance with system integration
- Two-year warranty; extended warranties available



- Easy-to-use proprietary path test equipment verifies radio path options to assure optimal signal



- Complete line of antennas, accessories, cables and connectors



- Complete factory training in application engineering, system administration and equipment maintenance & repair

Ask us for our technical paper on the advantages of using low RF power output in rural radio telephony applications.

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OPTAPHONE 2000 APPLICATIONS INCLUDE:

- Unserved Rural Communities & Businesses
- Geographically Isolated Subscribers or Payphones
- Emergency Cache for Disaster Relief Operations
- Remote Mining, Oil Field & Military Sites
- Lease-Line Emulation for Electronic Funds Transfer
- Slow-Scan Video Security Systems
- "BETRS" Service in USA

About OptaPhone Systems

The OptaPhone Systems division of Carlson Communications, Inc. is committed to the development and application of wireless technologies to meet the basic communication needs of rural communities and businesses around the world.

Carlson Communications is a privately held corporation managed by its owners in rural northern California. The company is continually researching and developing new wireless technologies to meet rapidly changing global communication needs.

Distributed By:



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